agricultural research

U.S. DEPARTMENT OF AGRICULTURE

AUGUST 1974

agricultural research

August 1974/Vol. 23, No. 2

The Number One Pollutant

Sediment is the prime mass-pollutant of the world's waterways. Formed mainly of soil and mineral particles washed into streams by storms, sediment has posed pollution problems for some 8,000 years—ever since the Sumerians invented irrigation to increase crop yields. Sumeria flourished for centuries, sustained by a canal system that impresses today's engineers. Unfortunately, the Sumerians cut down their upslope forests, engendering flash floods that swept vast quantities of silt off the denuded mountains into the irrigation ditches. When the irrigation system broke down, crops failed, people died, and the Sumerian civilization passed into oblivion.

The sedimentation problem is still very much with us, its effects reaching far beyond the stark statistic of 4 billion tons of sediment that move from land to water in the United States each year. First, there is the irreparable loss of soil, often millenia in the making. Second, sediment impairs the quality of the water in which it is entrained and carried. Third, sediment exacts economic and ecological tolls at the site of its ultimate deposition. Sediment occupies storage reservoirs, settles on productive lands, clogs harbors, fills lakes and ponds, destroys aquatic habitats, or damages water distribution systems.

Despite its antiquity, sedimentation has come under scientific scrutiny only in recent times. In the forefront of research on the "how" and "why" of this complex phenomenon is the USDA Sedimentation Laboratory erected in 1959 at Oxford, Miss. ARS researchers of varied disciplines—including soil scientists, hydraulic engineers, geologists, and mathematicians—are conducting studies not only at the Laboratory but at field sites around the country on such subjects as the laws of sedimentation, what initiates the movement of sediment, the velocity of water needed to erode a given soil, the sediment-carrying capacity of streams, and techniques of stabilizing streambanks. Some of these studies employ a 250-foot-long by 9-foot-wide test flume. Recent research focuses on the role of sediment as a carrier of such water-borne pollutants as plant nutrients, pesticides, and heavy metals.

Criteria developed by ARS researchers are forwarded to the Soil Conservation Service, the Corps of Engineers, and design engineers to aid in designing or redesigning specifications for use in local sediment control efforts. Sedimentation problems vary, depending on parent soil material and weather conditions, hence much information must be developed to meet particular situations. In time, however, research will enable resource managers to control sediment before calling for the dredge, thereby saving tax dollars and improving environmental quality for everyone.

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COVER: *Agasicles hydrophila,* the tiny South American flea beetle (seen at 15X), which was introduced into the United States in 1956, is now winning a biological battle against alligatorweed, which clogs lakes and waterways in the southern United States. The prodigious eater is only 4.5 millimeters long (0474X522–6A). Article begins on page 8.

AGRICULTURAL RESEARCH is published monthly by the Agricultural Research Service (ARS), U.S. Department of Agriculture, Washington, D.C. 20250. Printing approved by the Office of Management and Budget through June 15, 1977. Yearly subscription rate is $3.60 in the United States and countries of the Postal Union, $4.50 elsewhere. Single copies are 35 cents. Send subscription orders to Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. Use of commercial names and brands is for identification only and does not imply endorsement or approval by USDA or ARS. Information in this magazine is public property and may be reprinted without permission. Credit will be appreciated but is not required. Prints of photos are available to mass media; please order by photo number.

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Urban Plants vs. Pollution

Breeding red maples for urban environments. . .

DISCOVERY of wide variation in genetic traits of red maple trees stirs hopes for breeding improved trees that are able to withstand inhospitable urban environments.

Because of their colorful foliage, flowers, and fruits and their rapid growth, red maples are among the most popular trees in cities throughout Eastern and Midwestern States. These trees are already noted for their adaptability to urban sites, but plant geneticist Alden M. Townsend of the ARS Shade Tree and Ornamental Plants Laboratory, Delaware, Ohio, believes even better cultivars can be developed.

His research with red maples has been devoted to their adaptability to climate and air pollution and resistance to a disease called Verticillium wilt. Traits Dr. Townsend also considers important are tolerance to drought, soil compaction, and insects as well as appropriate size, growth rate, and good form.

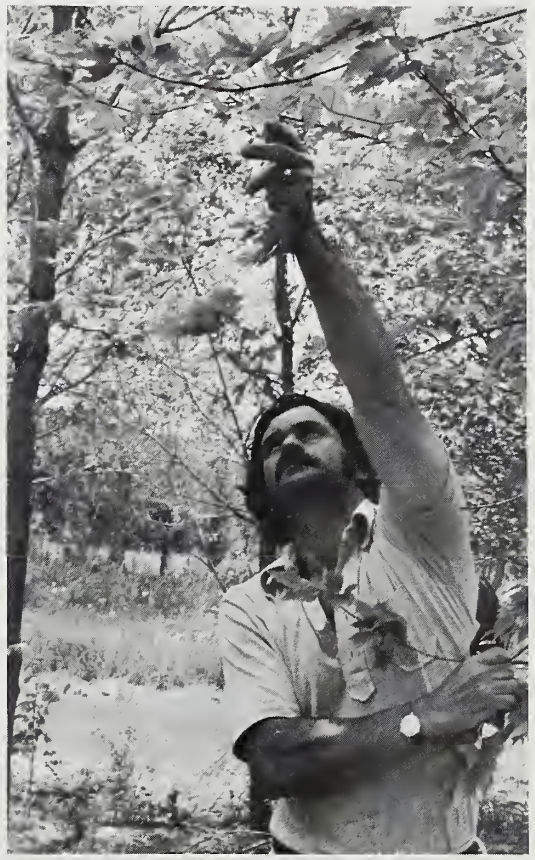
Conducting the genetic studies necessary to develop trees with a combination of these traits takes many years and investments too large for many commercial nurseymen or city arborists, Dr. Townsend said. With the help of many cooperators in the United States and Canada, red maple seeds were collected throughout the tree's natural range for studies in genetics and adaptation to environmental stresses. From the breeding material he hopes to develop hybrids with the desirable characteristics of superior parents, while removing undesirable traits.

Dr. Townsend found that red maple seedlings from some geographic sources have significantly more tolerance to fumigations of the air pollutant ozone (O_3) than from other sources. In cooperative studies with plant pathologist Leon S. Dochinger of USDA's Forest Service, also at Delaware, differences were noted in foliar injury, leaf growth, and height growth among seedlings of four sources fumigated at each of several growth stages (4, 11, 24 and 32 centimeters tall). Results of the experiments indicated that the degree of ozone sensitivity is controlled genetically at

In pollution tolerance experiments, plant geneticist Alden M. Townsend places a red maple seedling in a fumigation chamber with light, humidity, and temperature precisely controlled. He is studying the ability of young trees to take up and release carbon dioxide, ozone, and oxygen (0574X725–13).

Urban Plants vs. Pollution

Right: *Dr. Townsend describes variations in red maple seedlings grown from seeds collected in vastly different geographical areas. The shorter plant is the progeny of a tree growing in Newfoundland, while the taller seedling is the progeny of a Pennsylvania parent (0574X726–24).* ***Below:*** *As part of his research with red maple trees, Dr. Townsend planted this 8-acre site in 1974 with seedlings grown from seeds collected throughout the United States and Canada. Here, he and research technician Warren Masters (right) measure and record variations in plant growth of seedlings to assess their potential as candidates for cross-breeding and as selections for release (0574X727–6).*



Above: *Mr. Masters takes cuttings—or propagules—from a possible verticillium wilt resistant red maple tree. These cuttings will be used for further testing (0574X725–23).* ***Left:*** *Dr. Townsend and Mr. Masters root cuttings for wilt resistance testing. The cuttings will be "challenged" for wilt resistance through a series of inoculations with the disease and out-planting in selected geographical areas (0574X725–33).*

various stages of growth, and that seedlings can be selected for ozone tolerance at any of the stages.

In another aspect of the study, Dr. Townsend found that red maple seedlings which removed the most ozone from the air were most severely damaged by the pollutant. In choosing cultivars or species of trees for planting in areas of high air pollution, he said, growers may have to compromise between those that have ozone-absorption ability and ozone tolerance.

While there is some controversy about the effectiveness of plants in "purifying" the air, Dr. Townsend said trees may sometimes make the difference between an urban environment that is extremely hazardous to man and one that is bearable.

In a comparison study between ozone uptake by red maple and eight other tree species of similar height, Dr. Townsend found greater differences among the species than among red maple progeny groups. White birch seedlings absorbed more than twice as much ozone per hour as most of the red maples. In terms of ozone absorbed per unit weight of foliage, the difference was even greater. Concentrations of ozone used in the uptake study—above 0.10 parts per million (ppm) and below 0.30 ppm—are common in urban areas. In Pittsburgh and New York, concentrations are often above 0.3 ppm.

Another stress on red maples which Dr. Townsend studied with plant physiologist Bruce R. Roberts was the lack of soil moisture. Urban environments with hard-packed soils or restricted root space may compound the moisture problem. When deprived of soil moisture, seedlings from parents that grew on dry sites responded differently than seedlings whose parents grew on swamp sites, indicating genetic adaptation. Seedlings with origins in swamp sites grew rapidly, wilted, and died quickly; those from dry sites became semidormant and continued to survive.

Discovering the general adaptability of trees is closely tied to the red maple breeding program. Each progeny

group of seedlings is under test at several urban and suburban locations to determine its range of adaptation and also to determine whether various observed desirable traits are genetically controlled or are the result of environmental factors.

At Delaware, Ohio, seedlings from southern sources tended to be the fastest growing. Seedlings from northern sources tended to have the most highly colored foilage. There was considerable variation, however, among progenies from the same area. Dr. Townsend said some seedlings from trees within a 1-mile-square area may produce foilage with red coloration while others from the same area produce green foilage. "This degree of variation is encouraging," he said, "because it will enable us to make rapid genetic advances."

Dr. Townsend and plant pathologist Winand K. Hock (formerly of the ARS Laboratory) found the first red maple trees on record with tolerance to the widespread and destructive disease, Verticillium wilt. About one-fourth of the seedlings from one seed source showed disease symptoms on less than 10 percent of their leaves after two inoculations with the infective fungi. Some 80 percent of the leaves on susceptible varieties usually are affected.

Symptoms include wilting, yellowing, and interveinal browning of leaves. No cultural or chemical treatments can prevent the disease or reduce its severity. A reliable control method depends on the development and release of tolerant cultivars.

"What these studies have told us so far is that certain parent trees are superior in producing desirable seedlings," Dr. Townsend said.

When new urban trees with desirable characteristics are developed, wholesale nurserymen may request and receive propagating material. They increase the number of plants and return a small portion of them to ARS some 2 or 3 years later. At that point, a final release of the trees is made for widespread distribution. □

. . . Gaining knowledge of SO_2 effects

In a growth chamber equipped with precise environmental controls, Bruce R. Roberts prepares a stem tip from a privet plant for fumigation with SO_2 in studies on how air pollution affects woody plant (0574X724–29).

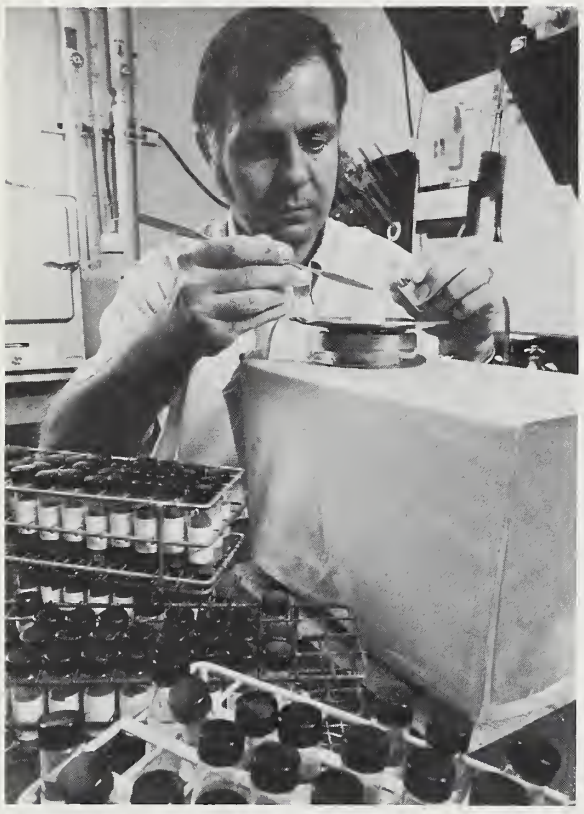
EXPECTING TREES in urban areas to survive while filtering considerable volumes of pollutants from the air seems like a big order, but studies are underway to help meet the challenge.

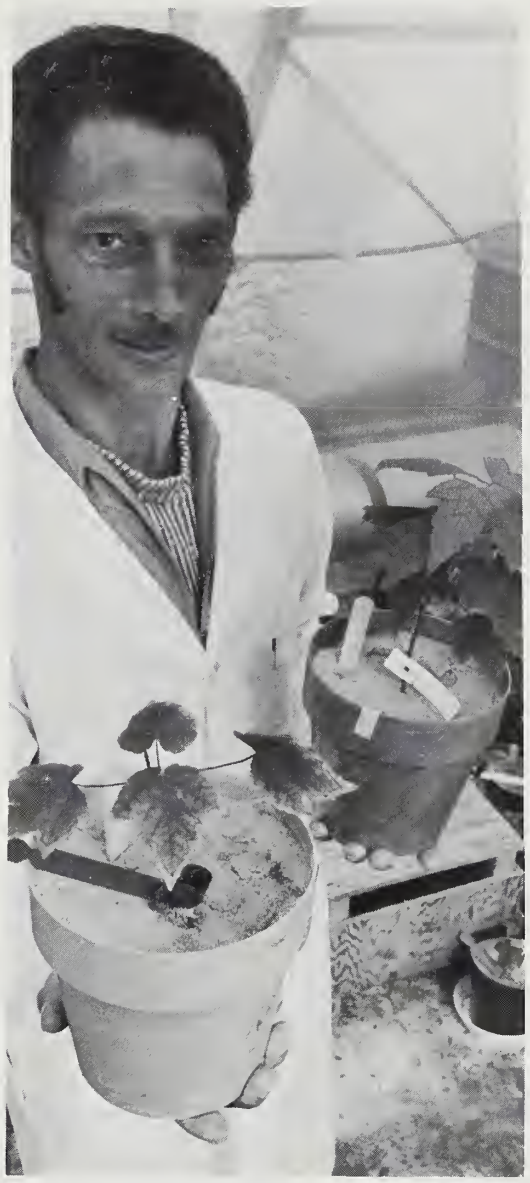
Plant physiologist Bruce R. Roberts of the ARS Shade Tree and Ornamental Plants Laboratory, Delaware, Ohio, has found significant differences in the ability of leaves of woody plants to take up sulfur dioxide (SO_2) from their micro-enviroment, the space immediately around their leaves. Red maple, white birch, and sweetgum seedlings took up more SO_2 than did rhododendron, white ash, and azalea seedlings.

Using precisely controlled conditions—temperature, light, and humidity—in a growth chamber, Dr. Roberts is gaining basic knowledge about relationships between woody plants and air pollution. He hopes this knowledge will ultimately enable him to recommend to city planners which trees, shrubs, or combinations of plants would be most suitable as "pollution fighters." This knowledge may also help scientists find ways to protect plants from pollution damage.

From his comparison study of different species, some rates of SO_2 uptake could be considered impressive. How-

Urban Plants vs. Pollution





Above: *In his pollution research, Dr. Roberts measures the sulphur content of plants grown under high and low levels of ambient SO_2. Here, he weighs the contents of vials containing the dried and ground stems, leaves, and roots of these plants. These will be subjected to colorimetric analysis after the sulphur has been converted to SO_2 through combustion (0574X723–25).*
Right: *An SO_2 fumigated red maple seedling (left) and control plant of the same species are displayed in a fumigation chamber by crops research helper Robert L. Haude. The fumigated plant shows the sort of damage found on trees growing in highly industrialized areas (0574X723–5A).*

ever, Dr. Roberts cautioned against projecting findings from precisely controlled microenvironments to macroenvironments. Changing weather conditions, such as wind and relative humidity, could have tremendous effects, both in terms of what they do to the plant and what they do to the pollutant, he said.

Of the major air pollutants—ozone, SO_2, nitrogen oxides, ethylene, and flourides—Dr. Roberts chose to work principally with SO_2. As a radioactive tracer, SO_2 can be used to find out what happens to the gas after it enters the woody plant. His work with radioactive SO_2 has just begun. He has observed, however, that SO_2 molecules are chemically altered soon after they enter the leaf—first they are oxidized to sulfites and then to sulfates. Some sulfuric acid (H_2SO_4) may be formed. Dr. Roberts said this chemical may account for some of the pollution damage to plants.

Sulfates can be used as nutrients by the plants. Dr. Roberts speculated on the possibility that sulfates derived from SO_2 may be translocated through the plant, excreted by roots, and used as nutrients by neighboring plants.

In a cooperative study led by plant pathologist Leon S. Dochinger of USDA's Forest Service, also at Delaware, and plant geneticist Alden M. Townsend of the ARS Laboratory, poplar cuttings of four genetic origins differed significantly in their susceptibility to SO_2 damage. The scientists made similar observations on genetic variability in red maple seedlings' ozone tolerance.

Photosynthesis can be affected by SO_2 pollution. The pollutant damages chloroplasts in the plant cells where photosynthesis takes place. Eventually, Dr. Roberts hopes to be able to diagnose the type and extent of pollution damage by examining affected cells.

Studies he conducted with Dr. Townsend and Dr. Dochinger indicated a reduction in photosynthesis as a result of SO_2 pollution. Red maple seedlings fumigated with 1 part per million (ppm) SO_2 for 4 to 6 hours took up slightly more carbon dioxide than unfumigated seedlings. In contrast, leaves of seedlings exposed to an SO_2 concentration of 6 ppm were severely damaged, permanently decreasing photosynthesis. Seedlings exposed to 4.5 ppm were damaged, but their ability to photosynthesize rebounded rapidly.

Results of experiments indicate that, unless plants are injured by the pollutant, SO_2 uptake remains constant over a 6-hour period. In some species of woody plants, Dr. Roberts also observed that the amount of uptake varied little, whether they were exposed to SO_2 concentrations of 1 ppm or 0.2 ppm. "We're not sure exactly what happens here," he said. "I think it involves the pollutant's effect on stomatal opening." Stomata are minute openings in the leaves through which gases enter and leave.

Dr. Roberts theorizes that stomata in the leaves of trees which are tolerant to shade may open and close faster, making these trees more tolerant to pollution. If this theory is borne out in further studies, plant breeders will be better equipped to select trees for pollution tolerance.

The plant breeders may, of necessity, compromise between selecting trees that tolerate pollution and those that absorb pollution well. Seedlings most capable of removing pollutants from the air have also been severely damaged. A compromise may enable city planners to alter extremely hazardous urban environments into bearable ones. □

Evaluating response to Newcastle vaccine

Since 1970, virulent strains of Newcastle disease have produced severe worldwide losses in poultry. If the disease becomes so widespread in the United States that it cannot be eradicated, an economical means of evaluating vaccination procedures will become necessary.

Present methods of vaccination have had highly varied results. Scientists think this extreme variability may be due to the particular strain and potency of the vaccine as well as the route of administration.

In studies at ARS' Southeast Poultry Research Laboratory in Athens, Ga., a simple and rapid microtest procedure was evaluated for measuring response of poultry to Newcastle vaccination. During a year's application in at least one large diagnostic laboratory in Georgia, the manual-microtest hemagglutination-inhibition (HI) procedure proved to be a very satisfactory compromise between the old test tube method (macrotesting) and a highly automated and expensive microtest method. The automated microtest method uses a machine costing $5,000 to $6,000 which automatically adds reagents and makes the dilutions.

Hemagglutination (HA) is the clumping reaction of red blood cells when suspended in a liquid that contains Newcastle disease virus. Specific antibodies directed against that virus will inhibit the hemagglutination.

ARS researchers employed commercially available manual microtest equipment in conjunction with inactivated HA antigen in the modified procedure. In many laboratories, the HI test often involves highly virulent HA antigens which may serve as a source of contamination in virus isolation attempts.

Blood samples were obtained with syringe and needle either from the wing vein of the chicken or by cardiac puncture and then placed in tubes treated with a silicone solution to aid in clot release. After clotting was adequate and the serum had been chilled at 4° C., sometimes overnight, it was harvested with disposable glass pipettes and placed in microtest plates.

Similar plates were prepared for serum dilution by adding antigen-saline mixture to each well. The sera were diluted until there was lack of inhibition of agglutination—evidenced by a distinct "button" of red blood cells in the bottom. From this end point the antibody titers were determined.

Using stock inactivated antigen and washed red blood cells which have been prepared in advance, an experienced technician can test as many as 700 sera in approximately 7 hours.

The serum-storage plate, developed by Southeast Poultry Research Laboratory scientist Dr. James E. Williams and biological laboratory technician Alton D. Whittemore, occupies minimum freezer space and allows simultaneous pickup and dilution of 12 sera, utilizing 12 microdiluters to each microdiluter handle.

Equipment costs are 10 times less for the compromise manual method than for the automated microtest method.

Described by veterinary medical officer Charles W. Beard and biological laboratory technician William J. Wilkes, the procedure also affords savings in reagents and makes possible a reproducible determination of antibody levels in serum. □

Little insect wins big victory

Above: *When photographed in August, 1972 heavy mats of alligatorweed plagued fishermen in this bayou—or creek—near Lake Pontchartrain, Louisiana (0872X1189–17).* ***Right:*** *Two years later this same bayou once again runs clear and fishermen enjoy pleasant hours thanks to the prodigious appetites of millions of tiny flea bettles (0474X555–29).*

The tiny South American flea bettle, Agasicles hydrophila, *and millions of its kin are eating their way through alligatorweed—their natural host, but a bane to many Southern waterways (0474X 552–1A).*

IT ALL STARTED with about 200 of them—delivered in a pint, cardboard container to a site on the Ortega River near Jacksonville, Florida in 1965.

Today, literally millions of these tiny, South American flea beetles (*Agasicles hygrophila*) are helping to keep waterways clear of strangulating alligatorweed. This aquatic weed was accidently brought into the United States in the late 1800's from South America and spread rapidly across the South.

The effectiveness of the flea beetles was illustrated at a site between Lake Pontchartrain and Lake Maurepas, about 40 miles northwest of New Orleans, La. (AGR. RES., Nov. 1972, p. 6). Here, as in other infested areas, alligatorweed was growing in large mats of hollow, interwoven stems floating near the surface and reaching out up to 50 feet from rooted portions near shore. So dense in some places, the floating mats took on the appearance of solid land. Now the large masses are disappearing and the water channels are beginning to reopen.

Agasicles flea beetles have been collected at release sites like the Ortega

Left: *Near Lake Pontchartrain, entomologist Neal R. Spencer, ARS, and aquatic weed expert William E. Thompson, U.S. Army Corps of Engineers, check for egg clusters—an index of* Agasicles *population levels (0474X558–35A).* ***Below:*** *Speeding along in an airboat, Federal and Louisiana State officials make an inspection tour on a waterway that, until the introduction of* Agasicles, *was clogged with alligatorweed. The weed will continue to grow in shallow water—a boon to hungry wildlife and livestock (0474X558–13A).*

River location, and relocated in nine southern States and California by ARS entomologists, staff of the U.S. Army Corps of Engineers, and State workers engaged in aquatic weed control.

Adult flea beetles feed on the leaves of alligatorweed; each female lays eggs, 1,000 or more, on the undersides of leaves. After hatching, young larvae chew circular pits in the under surface of the leaf. Mature larvae chew their way into the internode of the stem; the resulting adults chew their way through the stem wall and emerge.

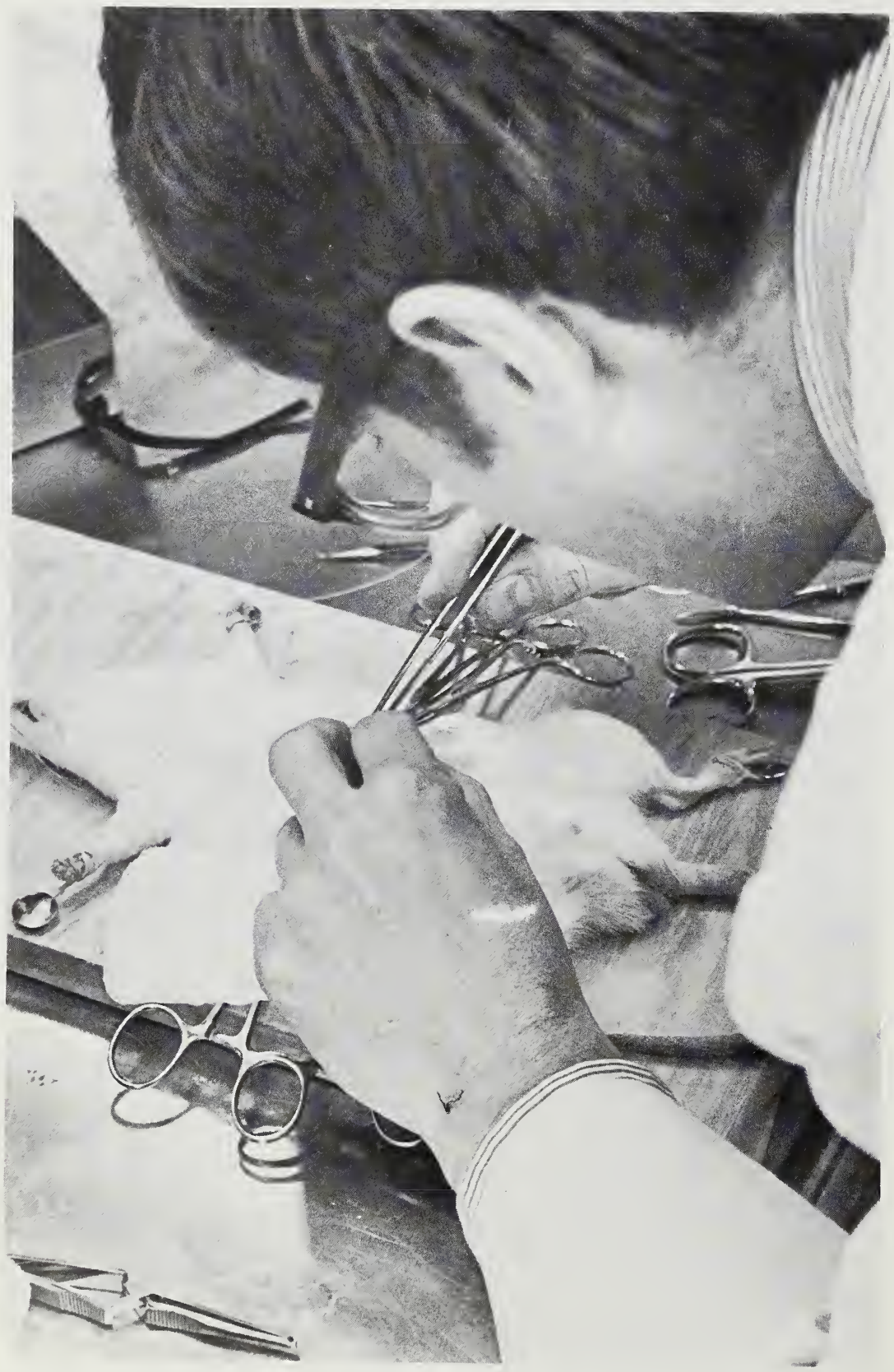
As the beetles "graze down" the alligatorweed, the plant must constantly push new growth to the surface. Its vitality sapped by the expenditure of energy to generate new growth and by the damage inflicted to the stems by the larvae, the weed dies or is finished off by competiiton from other aquatic plants, disease organisms, or wind and wave action.

As it is with any good guest, *Agasicles* comes and goes pretty much at the pleasure of its host plant. According to observations thus far, the flea beetle has not been found in significant numbers on any other plants at any time during its life cycle. Insect numbers rise and fall according to the amount of alligatorweed available.

Agasicles prefers to feed on the dense, floating mats of alligatorweed which clog waterways; it spares the alligatorweed rooted in shallow water or growing in moist terrestrial habitats, which serve as food and refuge for livestock and wildlife.

This insect, plus others being carefully introduced, tested and released by ARS scientists, will provide an effective, practical, and safe alternative to chemical weed control in the future. □

New insights into heart disease



To monitor cholesterol, its metabolites, and other substances in the bile of rats, medical officer Leslie M. Klevay inserts a tube into the bile duct of a rat. The flow of bile is interrupted daily for analysis in the search for the relationship between the zinc/copper ratio and the metabolism and cholesterol levels in the rats (PN–2860).

A PUZZLING ARRAY of medical opinion abounds on the causes of coronary heart disease, the leading cause of death in the United States. Now, a new theory is emerging which may help reconcile some of the opinions.

Research at the ARS Human Nutrition Laboratory, Grand Forks, N. Dak., shows that, in laboratory rats, cholesterol levels in blood plasma rise as the animals are fed a diet high in zinc relative to the amount of copper.

Humans with high levels of cholesterol in their blood are more likely to have heart attacks than persons with low cholesterol levels, medical officer Leslie M. Klevay said. High cholesterol levels are associated with the disease atherosclerosis, in which fat-like substances collect on artery walls. These deposits gradually reduce the amount of blood that reaches cells in the heart until injury results.

This condition is perhaps most widely attributed by medical authorities to the quality and quantity of fat a person consumes. Some researchers, however, have suggested other causes: consumption of soft water, high consumption of sucrose, low consumption of vegetable fiber, and lack of exercise.

Dr. Klevay said all of these hypotheses can be related to the zinc and copper in a person's body. Several studies have shown that the incidence of coronary heart disease is lower in areas where drinking water is hard. The amount of copper in hard water is generally greater than in soft water. Also calcium, which is high in hard water, may reduce the buildup of cholesterol in blood by moving zinc within the body out of the liver, decreasing the ratio of zinc to copper in that major site of cholesterol production.

Two other schools of thought on the causes of coronary heart disease, high consumption of sucrose and low consumption of vegetable fiber, are related, Dr. Klevay said. Diets that contain large amounts of sucrose, or refined sugar, are likely to contain only small amounts of vegetable fiber (AGR. RES., June 1973,

p. 4). Consumption of these diets is associated with increased risk of heart attacks.

Dr. Klevay added that many foods that contain unrefined carbohydrates—cereals, nuts, and legumes—are generally low in sucrose and contain fibers and phytic acid. Phytic acid forms chemical complexes with zinc, copper, and other trace metals. In alkaline environments, such as the small intestine, the copper complex is soluble while the zinc complex is not. Dr. Klevay said phytic acid may reduce the ratio of zinc to copper available for absorption.

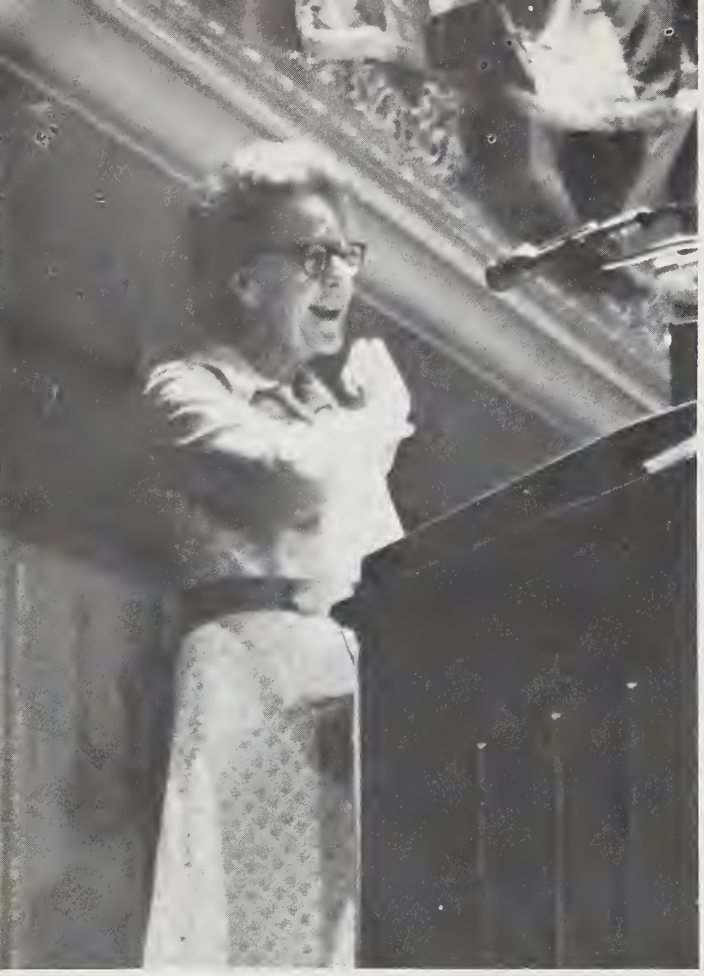
Another observation about atherosclerosis is that persons who exercise regularly are less likely to have heart attacks. Dr. Klevay said that sweating associated with vigorous exercise may help correct metabolic imbalances of zinc and copper. Research has shown that human sweat contains about 16 times as much zinc as copper.

An ideal balance of dietary zinc and copper for humans has never been determined. Accordingly, researchers at the Human Nutrition laboratory plan to increase their understanding of chemical and physiological mechanisms of zinc and copper in the body.

Dr. Klevay fed his experimental rats standardized cholesterol-free diets containing sucrose, egg white protein, corn oil, and distilled water. The amounts of zinc and copper in the diets were varied. He cautioned against interpreting the data he obtained for prescribing human diets. However, the ratios of zinc to copper concentrations in the rat diets were probably within the range of ratios in human diets. □

In the experiments at the Grand Forks laboratory, rat blood samples were taken, the cholesterol isolated, and reagents added to give color for analysis. Dr. Klevay pipets plasma cholesterol during the second step of the procedure (PN–2861).

Left: *Dr. Klevay removes one of the rats for testing. The zinc and copper were introduced into the rats in their drinking water. A total of 126 rats were used in three experiments—36 in the first series, 36 in the second, and 54 in the third. Eighteen rats were used each time as a control group (PN–2862).* ***Above:*** *Biochemist Robert Jacob operates the lab's atomic absorption spectrometer which is used to measure the amount of zinc or copper in material taken from the experimental rats (PN–2863).*



Noted British economist, author, and environmentalist Barbara Ward delivers the seventh Morrison Memorial Lecture before the American Society of Planning Officials at the Palmer House in Chicago, Ill. (PN–2866).

A writer, scholar, and educator, Miss Ward is noted for her penetrating analyses of international relations and the complex socio-economic implications of a world divided among developed and developing nations. Educated at the Sorbonne and at Oxford and a contributing editor for the *Economist* of London, Miss Ward held the Albert Schweitzer Chair of International Economic Development at Columbia University, N.Y., from 1968 to 1973. She was a consultant to the Secretary-General of the United Nations Conference on Human Environment in Stockholm in 1972, and at that time coauthored with Rene Dubos *Only One Earth*, a book that set the conceptual framework for that conference. She has published numerous other books and holds honorary doctoral degrees from many American universities and colleges.

1974 Morrison Memorial Lecture:

Priorities for 'Habitat 2000'

MAN MUST LEARN to comprehend scarcities in terms of the kind of planet he lives on—a planet on which limits are clear, materials are exhaustible, and energy supplies are of the same limited character. The most immediate problems man faces are poverty, urban congestion, pollution, and the extravagant use of energy.

These are the views of Barbara Ward, who presented the seventh Morrison Memorial Lecture. Miss Ward is a British economist, author, international environmentalist, and president of the International Institute for Environmental Affairs, London.

The 1974 Morrison Memorial Lecture was presented at the meeting of the American Society of Planning Officials in Chicago, Ill.; their conference theme was "The Politics of the New Scarcity." Morrison lectures are sponsored by ARS in honor of Benjamin Y. Morrison, first director of the National Arboretum.

In her lecture, entitled "Habitat 2000," Miss Ward cited priorities that global planners must consider during the next 25 years, if there is to be an earth fit for human habitation by the year 2000.

"Poverty is at the core of all problems, both in developed and developing societies," Miss Ward said. "Its existence side by side with growing wealth is a scandal and a disgrace. By the year 2000, the urban population of the developing world will have doubled to over 3 billion. At the same time rural population will also have doubled to over 2 billion. The interchange between the rural and urban sectors will go forward in catastrophic Niagara-like torrents of people moving into cities that are totally unprepared for this scale of movement. This will mean poverty that goes beyond any kind of human level of living."

In developed countries, she said, congestion in urban areas is complicated by the suburban spread—spurred by the automobile—"so that one city's spread meets the next city's sprawl."

Compounding the problem has been the energy spree spawned by technological developments in the past quarter century. "Energy scarcity," asserted Miss Ward, "goes to the root of every other problem. The heretofore cheapness of petroleum has underlined and determined the use of everything: agricultural and other technologies, the proliferation of the automobile, the urban-suburban crunch, and the degree of the world's pollution.

"Petroleum, itself, will run out early in the next century. So, the planners have about 25 years to make adjustments. The alternatives, until the world can tap something safe like solar energy,

are not necessarily cheaper, or without hazards and must be viewed with caution. Whether it is coal or off-shore drilling, or the gasification of coal, or liquification, or dealing with oil shales, or, indeed, the Faustian bargain of nuclear energy—there is not one energy alternative that does not involve much higher capital and environmental costs.

"At a 6 percent annual increase of energy wedded with technologies that are more environmentally disruptive, it is by no means clear," she said, "that we would not face the overall risks of violent, pervasive climactic changes as well as putting the oceans at risk. Certainly, the energy alternatives do not suggest another quick, cheap, and devastating option like petroleum."

However, Miss Ward feels there is no contradiction among the ideas of sane energy use, resource conservation, and a more constructive, humane method of running the world settlement. She said these factors should, in fact, reinforce each other.

"Even if prices have to go up, which they will, and even if conservation does not instantly level out inflation," she said, "we have, nonetheless, to make a commitment to the dire poverty which is a fact of our world. And if that commitment is not one of economics, it may be a commitment of common sense; it is most certainly a commitment of political energy and moral insight."

Miss Ward said the energy crisis this year could be turned into prophetic advice. Therefore, the drive for conservation may not be a defeat, but potentially a great victory. What may make this victory possible is the innate moral sense in all ethical traditions that restraint, neighborliness, and the ability to see other peoples' needs are not extras; they are the very core of a sane way of human existence. □

Insect control means healthier cattle

CATTLE PROTECTED against horse and horn flies are healthier and have greater muscular development than unprotected cattle, according to a 2-year sudy conducted by the Delta Branch Experiment Station at Stoneville, Miss.

ARS entomologist Richard H. Roberts said that test cattle, sprayed on a weekly basis with an insecticide mixture, were plagued by fewer flies and gained more weight than an untreated control group.

The cattle were sprayed with a water-based spray containing 0.5 percent methoxychlor, 0.5 percent carbaryl, 0.1 percent pyrethrins and 1.0 percent piperonyl butoxide.

The day before and after each treatment, the number of horse flies and horn flies were counted on all animals between 1 p.m. and 3 p.m. Previous data showed that a greater percentage of flies fed on the cattle at that time of day.

Hemoglobin and hematocrit values (ratio of red blood cells to the volume of whole blood) were obtained every 2 weeks to determine whether blood reproduction capabilities had any reaction to insect feeding.

The animals were weighed every 4 weeks during the study. In an attempt to standardize weights through the evacuation of the intestinal and urinal tracts, the cattle were weighed after an 18-hour shrink period, during which the cattle were not allowed to feed or drink.

Results showed that control of horn flies was excellent. Control of horse flies ranged from good to excellent the day after the treatment, to fair the day before the next treatment a week later.

During one year's tests, on the day before the next treatment, results showed a 100-percent reduction in the number of horn flies on the treated cattle over the untreated group.

The following year, there was a 98-percent reduction over the untreated group.

The treated group showed a 53-percent reduction of horse flies over the untreated group the first year, and a 75-percent reduction the next. The 22-percentage-point range was attributed to field variability and weather conditions.

During the first year the treated steers gained an average of 0.20 pounds per day per animal over the untreated steers; the next year, the gain was 0.23 pounds per day per animal under pasture conditions.

The treated group, under feedlot conditions, had an average daily weight gain slightly higher, while requiring less feed per pound gained than the control group. During the first year the treated group required .45 pounds less feed per pound of gain than the control group, while during the following year, the treated group required .59 pounds less feed per pound gained.

Carcasses of the test cattle were evaluated for dressing percentage, conformation, marbling, USDA carcass grade, fat thickness, and yield grade. Dr. Roberts said the carcass value quality of the treated group tended to be slightly better than the untreated control group. The animals treated with the spray were also easier to handle and did not exhibit the wildness that characterized the untreated group. □

Gizzard size linked to broiler problems

DIFFERENCES in the weight of gizzards and in the separation between the glandular stomach and the gizzard may be the key to solving some of the problems of producing cage-reared broilers.

Research indicates that cage-reared broilers receiving a basal diet like that used in commercial operations, have significantly lighter gizzards, when expressed as a percentage of body weight, than do floor-reared broilers on litter diets. The separation between the proventriculus (glandular stomach), and the gizzard is also less prominent in caged broilers on the basal diet.

Nutritionist Leon F. Kubena, and his associates, working at the ARS South Central Poultry Research Laboratory, Mississippi State, Miss., have discovered that gizzard size is influenced by diets containing ground litter or ground oak shavings. The gizzard, the muscular posterior stomach of chickens, grinds and crushes coarse, heavy food particles for better digestion.

Gizzard size may have some effect on injuries to cage-reared broilers. Problems encountered with cage-reared broilers include broken bones, leg problems, breast blisters, and body fat content during meat production; and fatty liver syndrome, cage fatigue, brittle bones, and shell problems during egg production.

Dr. Kubena's research, conducted in an environmentally controlled house, involved commercial broilers of both sexes. All broilers were fed a basal diet containing 23-percent protein with a metabolizable energy value of 3,306 kilocalories per kilogram of diet for the first 4 weeks. During the second 4 weeks, the diet consisted by 21-percent protein with a metabolizable energy value of 3,372 kilocalories per kilogram of diet.

Test groups consisted of floor-reared and cage-reared broilers fed only the basal diet, cage-reared broilers fed a basal diet plus 3-percent ground litter, and cage-reared broilers fed a basal diet plus 3-percent ground oak shavings.

In each trial, at 8 weeks of age, approximately 30 males and 30 females were randomly selected, weighed, and their gizzards removed. The gizzards were then cleaned with the lining intact and immediately weighed.

Analysis of variance for gizzard weight was performed by Arcsine Percentage Transformation (tabular conversion to percentiles), for gizzard weight as a percentage of body weight.

Cage-reared broilers on the 3-percent litter diet had significantly heavier gizzards (3.85 grams greater) than the cage-reared broilers on the basal diet. Both groups had gizzard weights lower than those of the floor-reared broilers.

The cage-reared males receiving the diet with 3-percent ground shavings had gizzards equal in weight to the floor-reared males on the basal diet, while the cage-reared females on the diet with 3-percent ground shavings had gizzards heavier (.71 grams greater) than the floor-reared females on the basal diet.

Increases in gizzard weight in the floor-reared broilers and the cage-reared broilers on 3-percent litter or ground shavings diets might be a developmental response of muscle tissue produced by the physical features of the ground litter or shavings, Dr. Kubena said. It is also possible that physical exercise might be a factor, since the caged broilers are more confined than the floor-reared broilers. □

The AS–1 type of cyanophage, magnified 21,000 times in this photomicrograph taken by plant pathologist Paul R. Desjardins, is characterized by the polyhedron head and contractile tail. The sheath of the tail contracts (upper specimen) exposing the core which injects DNA into host cells. Like certain bacteriophages, the AS–1 reproduces within its host causing a distintegration of host cells (PN–2865).

Viruses for control of algal blooms

CERTAIN VIRUSES may become important biological agents for controlling undesirable species of blue-green algae—those that form algal blooms in eutrophic waters.

These blooms form in upper layers of water, float to the surface and die, resulting in an unpleasant, rotting scum that spoils recreational water use. This decreases the oxygen content of the water, causing fish kills and further polluting the water.

The viruses, called cyanophages or phycoviruses, were first discovered by microbiologist Robert S. Safferman, U.S. Public Health Service, Cincinnati, Ohio, in 1963. At that time, Dr. Safferman envisioned their control potential. Since then, however, only five groups have been isolated and characterized by host range. The first three groups were isolated by ARS scientists in collaboration with the U.S. Public Health Service. Even today, little is known about the biological potential of cyanophages in ecological management.

Of the five genera of blue-green algae that are commonly involved in algal blooms and that are fairly well distributed, worldwide, only two—*Microcystis* and *Nostoc*—are reported to have species attacked by these viruses. Recently, Soviet scientists claimed experimental success in employing a virus isolated from the blue-green alga, *Plectonema boryanum*, to clear a Microcystic bloom in a large reservoir in the Ukraine.

In recent ARS-sponsored research, Indian scientists isolated three viruses that infect non-blooming algal species, including a species previously unknown as a host. Plant physiologist Lowell D. Owens, ARS-cooperating scientist, Beltsville, Md., said the Indian research adds further to the possibility that viruses exist for many or most blue-green algae.

"Conceivably," Dr. Owens said, "some of these viruses could be added to the arsenal of biological controls. Much research needs to be done, however, on manipulating viral genetic material, understanding inherent properties of both viruses and hosts, and in understanding the effects of environmental fluctuations on the virus-host relationship."

Of additional scientific importance is the host-specificity of many of these viruses. Knowledge of this could help in classifying blue-green algae, a phylum that, at present, has a confusing taxonomy.

The Indian project was conducted under the provisions of P.L. 480 at the Banaras Hindu University, Varanasi.

Deticking agent shows promise

A FAMILY of chemicals called formamidines shows promise as tick detaching agents. This family of organic chemicals has a unique, but not yet understood, mode of action against ticks which attach themselves by imbedding their mouth parts in the skin of warm-blooded animals, including man.

Heretofore, there has been no satisfactory means of removing ticks either from one's body or from animals. The means most often resorted to were turpentine, a mixture of pine tar and vegetable oil, insecticides, or even heat from a lighted cigarette.

These methods are all undesirable because they generally kill the ticks before they detach, making it necessary to pull them off. Removal frequently leaves mouth parts of the ticks imbedded in the skin, causing secondary infections.

The most completely tested of the chemicals to date is chlordimeform. It has been used in the laboratory against three species of ticks, the lone star tick (*Amblyomma americanum* L.), brown dog tick (*Rhipicephalus sanguineus* Latreille), and the Rocky Mountain wood tick (*Dermacentor andersoni* Stiles).

As a deticking agent the compound was more effective against adult ticks than against nymphs, but it was more toxic to nymphs. It was highly effective in causing ticks to detach and also caused a slow kill of most of the detached ticks.

In the research, conducted at the U.S. Livestock Insects Laboratory, Kerrville, Texas, ARS entomologists William J. Gladney and Roger O. Drummond, and biological technician Stanley E. Ernst found that only very small amounts of

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AGR 101

the chemical were necessary to cause ticks to detach from guinea pigs.

Concentrations tested ranged from a low of 0.03125 percent to a high of 1.0 percent. At the 0.5 to 1.0 percent level, 83.9 to 85.5 percent of the adult lone star ticks detached within 2 hours of treatment. At the 0.125 to 0.25 percent level, all adult brown dog ticks and all Rocky Mountain wood ticks detached within 2 hours of treatment.

Whitewash improves melon yields

YIELDS of marketable Crenshaw melons could be increased by $400 per acre if growers used a "whitewash" spraying technique. ARS scientists who tested the technique report that with cantaloupes the yield increase would be about half as great. Cost estimates for application of the spray are about $12 per acre.

A field of melons is harvested six times or more during the season to get fruit at the right stage of ripeness. After the third or fourth harvest, the vines are often too damaged to adequately protect the melons from solar radiation.

Spraying the melons with chemically inert aluminum silicate helps eliminate solar injury and sunburn. The "whitewash" screens the sun's damaging heat and other solar rays from the exposed melons. Too much sun overheats the melons, causing unsightly brown, sunken areas. Crenshaws are particularly susceptible to solar damage because, unlike cantaloupes, their surface is not covered with a shallow ribbing pattern called a protective net.

The researchers sprayed both melons and vines with a conventional weed sprayer. Seventy-five pounds of aluminum silicate mixed with 100 gallons of water and 1 pint of surfactant cover 1 acre of melons. The surfactant helps spread the spray more evenly.

When the Crenshaws are harvested, laborers wet-sponge off the protective "whitewash." This step can be done either in the field or packing shed. Cantaloupes can be mechanically brushed and cleaned in the packing shed with brushes that contact all parts of the melons.

The "whitewash" techniques proved highly successful in field tests conducted by ARS over the past three seasons. Plant physiologist Werner J. Lipton, at the U.S. Horticultural Field Station, Fresno, Calif., expects melon growers in California, Arizona, and Texas to profit from this new technique and consumers to be able to buy higher quality melons.

The technique is already used for protecting tree trunks, tomatoes, and walnuts from the sun.

When reporting research involving pesticides, this magazine does not imply that pesticide uses discussed have been registered. Registration is necessary before recommendation. Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if not handled or applied properly. Use all pesticides selectively and carefully.

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